ECHOCARDIOGRAPHIC EVALUATION OF PATIENTS OF ESSENTIAL SYSTEMIC HYPERTENSION RECEIVING EITHER BETA BLOCKER OR ACE INHIBITOR – A COMPARATIVE STUDY

THESIS

FOR

DOCTOR OF MEDICINE
(INTERNAL MEDICINE)

BUNDELKHAND UNIVERSITY
JHANSI (U.P.)

2004   **RUPESH SINGH**
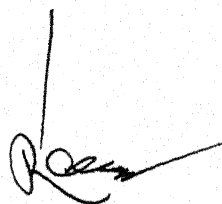
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The work has been carried out under my direct supervision and guidance. The techniques and statistical methods used in this thesis have been undertaken by the candidate himself and checked by me from time to time.

He has put in the necessary stay in the department as per University regulations.

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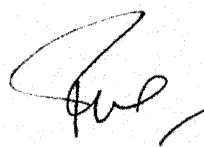Department of Medicine
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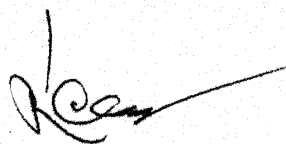Maharani Laxmi Bai
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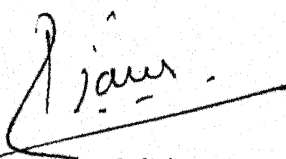## MEDICAL COLLEGE, JHANSI

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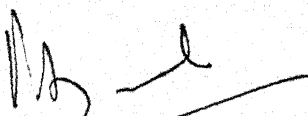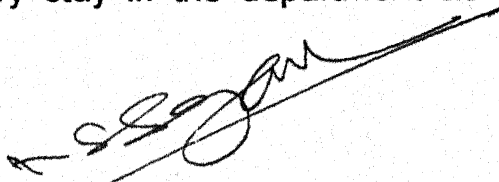## MEDICAL COLLEGE, JHANSI

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ACKNOWLEDGEMENT

It would take pages, to acknowledgement everyone who in sometime who in someway or the other helped me along my path reaching this goal, but certain individuals need special thanks for their valuable help.

First and foremost, with all my heart I would like to express my deepest gratitude and privilege for having been associated with **Dr Praveen Kumar Jain** MD, DM, Professor of Cardiology, Department of Medicine Maharani Laxmi Bai Medical College, Jhansi for his enlightened guidance which steered me towards the harbour of success. I am greatly thankful for the ceaseless attention, he has paid to my problems, always sparing a few moments for me even amidst the busiest of schedules without which this work would not have seen the light of day.

"The habits of punctuality, order, diligence, determination and concentration are the key to success". That is what has been inculcated into us by our honorable Head of Department and my Co-Guide, **Dr.R.C. Arora** MD,DSc Department of Medicine, M.L.B. Medical College, Jhansi.

I am also greatly thankful to **Dr P. K. Jain** MD, MNMAS, Professor of Medicine M.L.B. Medical college Jhansi. His sense of precision, inflinching tenacity, passion for reason, compassion towards patients, knowledge and

experience was a constant source of inspiration to me. It was under his able guidance I read, learned and ventured to write. I take this opportunity to acknowledge most humbly with a deep sense of gratitude and indebtness to Dr Navneet Agarwal, MD, Professor of Medicine, M.L.B. Medical College Jhansi. His encouragement helped me to carry out this present work.

I am very thankful to Dr N. S. Senger, MD, DM, Asst Professor in Nephrology, whose time to time highly valuable inputs helped me a lot.

I am also very thankful to my wife Dr. Rashmi who by her boundless cooperation, unconditional and firm support has been a constant source of inspiration.

I am equally thankful to all the patients and their relative whose positive response throughout the study encouraged me for this endevour.

I would like to express my thanks to Mr. Shashank Jain Chief of NET.SOL Computers for the pain he took in helping me prepare a presentable and neat work to submit.

I shall faith all my thanks if do not convey all my thanks and respect to all the people who took part in this work and helped me to complete this study and reach conclusion.

Dated: 24/1/14

(Dr. Rupesh Singh)

CONTENTS

INTRODUCTION

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Hypertension is an important public health problem in developed countries and with changing life style and increasing longevity it is now a major cause of concern for health service providers in developing countries too. It is a common, asymptomatic, easily detectable, usually easily treatable disease yet, it leads to lethal complications as in majority it is either untreated or is partially treated.

Untreated hypertension increases the risk of vascular damage involving both small (resistance) arteries and arterioles and large (conduit) arteries. These lesions lead to cardiac, renal and cerebrovascular morbidity and mortality.

Although diastolic dysfunction is the earliest evidence of involvement of heart in hypertension. This is not pathognomonic of hypertensive heart disease, as similar changes may be present in aged persons or patients having coronary artery disease, unrelated to hypertension. Left ventricular hypertrophy (LVH) is therefore considered a hallmark of hypertensive heart disease, as systolic dysfunction usually appears late in course of disease. Patients with left ventricular hypertrophy have increased risk of angina pectoris, acute coronary syndrome, ventricular arrhythmias, sudden cardiac death (SCD) and congestive cardiac failure. Thus LVH emerged as

an independent risk factor for future adverse event, unrelated to stage of hypertension.

The other predictor of future adverse events like elevated systemic blood pressure, ejection fraction, fractional shortening is less sensitive. Regression of left ventricular hypertrophy occurs with treatment without deterioration in left ventricular performance. So there is a need to detect cardiac dysfunction in Hypertensive patients as early as possible.

Routinely employed chest-X ray or ECG cannot be used for assessment of left ventricular hypertrophy as they are less accurate and do not provide quantification of left ventricular mass. Angiocardiography is an accurate method of LVH assessment but its invasive nature and potentiality of complications, do not support its use in relatively benign condition like hypertension for left ventricular function estimation. In contrast, echocardiography provides a simple, safe, reproducible and accurate method and modality of choice to define left ventricular hypertrophy and dysfunction.

An early detection and prevention of LV dysfunction is an important goal in the management of hypertensive patient. A number of effective in-expensive anti-hypertensive agents are available for treatment of hypertension but an enigma remains for physicians in choosing/selecting best of these. Although there is definite indication

of specific anti-hypersensitive agent in specific condition/ co-morbidities associated with hypertension. In majority of hypertensive patients, there is no specific choice of anti-hypertensive agent. Probably in these patients the optional choice of anti-hypertensive agent is, that anti-hypertensive agent which not only controls hypertension effectively but also regresses/reduces the risk factors associated with it in form of cardiac dysfunction.

REVIEW

OF

LITERATURE

REVIEW OF LITERATURE

The end of natural history of untreated hypertension is an increased likelihood of premature disability or death from cardiovascular diseases/ the pathogenesis of hypertension involve structural changes in the resistance arterioles described under term remodeling and hypertrophy.

Diastolic and systolic dysfunction have been observed early in the course of hypertension and either or both may lead to heart failure. Such disatolic dysfunction may reflect more vigorous atrial emptying (Ahmed et al) or abnormal diastolic relaxation (de Simone et al). In established hypertension abnormal relaxation has been observed in two trials of patients with normal LV systolic function (Rusconi et al).

Left ventricular hypertrophy (LVH) is detected in 25% t0 305 of all hypertensive patients and in 1% to 9 % of normotensive individuals . When present concomitant to hypertension, LVH is initially a useful compensatory process that represents an adaptation to increased ventricular wall stress. However, LVH is also the first step toward to development of overt clinical disease such as congestive heart failure, cardiac, dysrhythmias, and ischemic heart disease.

LVH represent an important risk factor for cardiovascular morbidity and mortality, independent of causal blood pressure, and more powerful than hypertension per se, cigarette smoking, or

hypercholesterolemia [1] . In fact, a large number of studies have noted, in both clinical and epidemiological populations, the relationship between LVH at baseline examination and the risk of subsequent morbid or mortal events.

A number of studies have used electrocardiographic criteria to document the relationship between LVH and an adverse prognosis[2-5]. The Framingham Heart study has shown that LVH detected by electrocardiography (ECG) increases the risk for coronary heart disease, sudden death, cardiac failure , stroke and occlusive peripheral arterial disease. The study also found that St and T – ware abnormalities enhance the risk associated with increased R – wave amplitude, suggesting that the risk attributed to LVH found by ECG is caused not only by hemodynamic overload but also by the coexistence of coronary disease.

Echocardiography is a specific and repeatable technique for the assessment of cardiac anatomy and function. It is more sensitive than ECG for the diagnosis of LVH Direct measurement of left ventricular mass (LVM) by echocardiography has proved this parameter to be a strong predictor of subsequent morbidity and mortality . In several studies patients with LVH, measured as high LVM consistently had at least two- to- four – fold higher rates of cardiovascular complications than hypertensive individuals without LVH, although differences existed in the rate of adverse events depending on the end point considered and in the level of risk in the population being studied.

The echocardiographic technique has demonstrated that the geometric adaptation of left ventricle to increased cardiac load may

differ among patient. The three variations of adaptation are concentric remodeling concentric hypertrophy, and eccentric hypertrophy. Concentric remodeling occurs with an increase of thickness with respect to radius, without an increase in mass. Concentric hypertrophy is characterized by increased mass and increased relative wall thickness. Eccentric hypertrophy characterized by increased mass while relative wall thickness remains below 0.45 . Concentric hypertrophy appears to carry the highest cardiovascular risk, followed by eccentric hypertrophy with an intermediate risk. Concentric remodeling seems only to be associated with a small though consistent risk .[11] In the Framingham study, individuals with concentric hypertrophy also had the greatest LVM. Any increase in rate of unfavorable clinical out comes seen in this group of patients was largely attenuated after adjustment for baseline differences in LVM and cardiovascular risk factors.[12] It has been concluded , therefore , that knowledge of the left ventricular geometry provided little prognostic information beyond that derived from evaluation of LVH and major cardiovascular risk factors.

Several mechanism have been proposed to explain the association of LVH with increased cardiovascular risk.[13,14] Firstly . LVH may lead to diastolic filling abnormalities that predispose to congestive heart failure. Secondary, LVH may be associated with dysfunctional autonomic nervous system activity and reduced coronary reserve.

Thirdly, LVH may predispose to ventricular arrhythmias and a greater risk of sudden death. In addition, LVH may be a sensitive

indicator of changes in vascular structure in both large and small arteries.

Echocardiographic determination of midwall shortening is a sensitive method for evaluation of ventricular function,[15] and can identify a consistent proportion of asymptomatic hypertensive patients exhibiting reduced left ventricular myocardial performance as well as hemodynamic characteristics associated with increased cardiovascular risk. It has been proposed that the presence of depressed midwall shortening is a predictor of adverse outcome in arterial hypertension and that the combination of increase LVM and reduced midwall shortening identifies patients at markedly increased risk.[15]

Determinants of left ventricular mass in hypertension

Arterial pressure

Arterial blood pressure is usually considered the most powerful determinant of LVM in hypertension; However, LVM correlates poorly with casual systolic and diastolic blood pressure. Blood pressure fluctuates from beat to beat and it is therefore unlikely that a few blood pressure measurements can be representative of the total pressure burden of a hypertensive individual. However, the use of ambulatory blood pressure techniques have permitted the finding of a closer correlation between 24- hour average blood pressure and LVM.[16]

Much attention has been directed recently to the importance of daytime and night-time values of blood pressure and, in particular, to the lack of nocturnal decrease of blood pressure in patients with LVH.[17] However , it has been observed that the subdivision of

patients into 'dippers' is at present only arbitrary , and that the reproducibility of classification into these two categories is rather poor. It should also be considered that a blunted diurnal blood pressure rhythm could be the consequence and not necessarily the cause, of target – organ damage and LVH1.[18]

The prevalence of LVH increases progressively with age .[19] This trend has been observed not only in hypertensive patients but also in normotensive individuals. The increase in LVM with age may be largely explained by a reduction in aortic impedance an increase in blood pressure and possibly the presence of subclinical degenerative processes (i.e., fibrosis or amyloidosis). In some studies, it has been found that for any given level of arterial blood pressure, black patients have larger LVM than white patients with comparable parameters. The Framingham study has shown that in those under 50 years of age, LVH is more common in men, while in those over 50 years of age LVH is more common in women. The increase in LVM with age seems to be more pronounced in women. Obesity is also strongly related to LVH which is more frequently of the eccentric type.

Offspring of hypertensive patients seem to have a grater LVM than that seen in the general population , although it is not clear whether this might just be a consequence of slightly higher blood pressure values in the offspring. In addition several studies have indicated that hypertension is frequent in normotensive individuals with increased LVM.[20, 21]

In recent years, several studies reported a relationship between polymorphism of the reninangiotensin system (RAS) gene and

cardiovascular structural changes of disease. Although there is some evidence of an associated between RAS gene polymorphism and LVH, the association is not predictable. Further studies are needed to define genetic characteristics that may be accepted as generalized susceptibility markers for LVH.[22-24]

It has been shown in several studies that LVM is correlated with the degree of urinary sodium excretion over 24 hours, which is a measure of daily salt intake. [25]Intravascular volume increase when sodium intake is high, with a consequent development of eccentric LVH. Conversely, low salt intake reduces or prevents the development of LVH.

Recently, it has been shown that LVH is common in chronic alcoholics with essential hypertension.[26] This may be related to the stimulating effect of alcohol on the sympathetic nervous system and. /or to its direct effect on vascular smooth muscle.

Experimental studies indicate that noradrenaline is able to induce LVH, even at subpressor doses. The importance of sympathethic nervous system activity in facilitating the development of LVH in essential hypertension in humans is not known.[27] LVH is not frequent in patients which pheochromocytoma.[28] However, patients with essential hypertension often have impaired cardiopulmonary reflexes and a reduced response to beta-adrenergic stimulation.

He results of several experimental and a few clinical studies have suggested that both the RAS and the excess of aldosterone play an important role in the pathogenesis of LVH. In experimental trials, angiotensin II was found to cause hypertrophy and/or

hyperplasia in myocardial cells. Further more , excess aldosterone has been related to extracellular matrix and collagen deposition and there fore to myocardial fibrosis.[29] Definitive proof of the contribution in humans of the RAS and aldosterone excess to the pathogenesis of LVH and myocardial fibrosis is still lacking, although their role is suggested by findings in patients with primary aldosteronism and renovascular hypertension .[30,31]

Other humoral factors related to the presence of LVH include parathyroid hormones, growth hormone, and insulin.

Long- standing LVH leads to impairment of contractile function with progressive dilation of the left chamber and finally, to the development of congestive heart failure. Left ventricular pump function may show early impairment during exercise, concentric LVH is frequently associated with a reduced midwall fractional shortening.

Left ventricular compliance is reduced by thickening of the ventricular wall. Diastolic dysfunction of LVH is related to both decreased early- diastolic relaxation and decreased late –diastolic compliance. LVH is frequently associated with ventricular ectopy . The mechanism for such arrhythmias is not clear, but appears to related to the process of hypertrophy and accompanying fibrosis, in addition to coexisting coronary artery disease or possibly to diuretic – induced hypokalemia. Whether ventricular ectopy can explain the increased prevalence of sudden death observed in patients with LVH remains to be demonstrated.

A decrease in coronary reserve parallels the development of LVH in hypertension. This impairment in coronary reserve is related to disease of the large coronary arteries and to cardiac microvascular

disease, as well as to an increased hemodynamic load and an increased left ventricular muscle mass, both of which require more oxygen.

Several hundred human and experimental studies have established that blood pressure reduction may reverse hypertensive LVH. Recent evidence from the study on Ambulatory Monitoring of Pressure and Lisinopril evaluation (SAMPLE) has shown that this regression is more accurately predicted by measurements of average blood pressure, using ambulatory monitoring, than by clinic or home blood pressure recordings.[32] Non – pharmacological intervention, such as weight reduction or reduced dietary salt intake, also leads to a successful reduction in LVH.[25,33]

The various classes of antihypertensive drugs differ in their ability to reduced LVM. The reason for this disparity may be due to differing effects on certain non- hemodynamic factors , such as the RAS, the sympathetic nervous system, and other growth factors , which may contribute to either the development or the reversal of LVH.

This hypothesis was suggested for the first time in reports of the elegant studies of Sen and Tarazi of spontaneously hypertensive rats.[34] The researchers observed that although methyldopa, hydralazine, and minoxidil resulted in an equivalent reduction of blood pressure, ventricular mass was reduced after treatment with methyldopa but increased after treatment with minoxidil. Sen and Tarazi suggested that the failure of direct vasodilators to regress LVH may be result of adrenergic stimulation.

In humans, few studies with sympatholytics, including methyldopa, clonidine and reserpine have reported a significant regression of LVH. One study reported that methyldopa led t a significant reduction of LVM despite only small changes in blood pressure. [35] However, vasodilators such as minoxidil and hydralazine did not induce any significant regression of LVH despite a satisfactory control of blood pressure.[36]

Angiotensin – converting enzyme (ACE) inhibitors, which reduce blood pressure through peripheral vasodilation but, in contrast to other vasodilators, do not induced reflex adrenergic stimulation, consistently reduce LVH. Conflicting results have been reported with the use of diuretics and beta- blockers; although most studies with these agents have reported that the antihypertensive effect of these agents is associated with a reduction in LVM.[37] Recent studies have suggested that indapamide may be more effective than other diuretics in reducing LVH.[37] The various pharmacological classes of calcium – channel blockers have all been found to have significant reducing effects on LVM, despite the tact that dihydropyridine compounds are sometimes associated with measurable, albeit small , adrenergic stimulation.[38]

Dahlof et al performed a meta- analysis of all relevant published studies on echocardiographically demonstrable reversal of LVH obtained through the use of antihypertensive drugs.[39] A total of 109 studies comprising more than 2300 patients were considered . Dahlof et al concluded that ACE inhibitors, beta- blockers, and calcium-channel blockers all reduced LVH by reversing wall hypertrophy, whereas diuretics reduced LVM mainly by decreasing left ventricular

volume. The authors calculated in these meta- analyses that the reduction of LVM was most pronounced with ACE inhibitors similar conclusion were reached by Cruickshank et al in their meta-analysis of 104 published studies.[40]

However, these data cannot be considered definitive because of serious limitations in the studies. In fact most of the studies considered in this meta-analysis were small (involving an average of 10-15 patients per patients per study), open nonrandomized, and non- coomparative. Further problems include short study durations (less than 6 months), poor characterization of patients, and lack of blinding of echocardiographic measurements.

In a later meta-analysis , Schumieder found only 8% (39/471) of available studies that were randomized , double-blind, parallel, group comparisons, were performed in patients with World Health Organization (WHO) class I or II hypertension without concomitant cardiac disease.[41] The analysis indicated firstly that the fall in blood pressure and the initial LVM determines the reduction of LVH, and secondary that both ACE inhibitors and calcium- Channel blockers are more effective than beta- blockers or diuretics in this respect.

In addition, it should be considered that the efficacy of different classes of drugs on specific patient's populations may modify the final effect on LVH. Dahlof et al observed a greater effect on LVM of ACE inhibitors compared with diuretics in a group of 28 Caucasian men.[42] Schulman et al found that a calcium- channel blockers induced a greater reduction in LVM than induced by a beta blockers in a group of 42 elderly patients, predominantly of the African- American race.[43] These results correspond with the expected differences in efficacy of

different classes of antihypertensive drugs between black and white, and young and elderly patients.

In the large multicenter Treatment of Mild Hypertension Study (TOMHS) a total of 819 mildly hypertensive individuals underwent an echocardiographic study at baseline then at least once during the 4-year treatment period.[44] All study participants received a highly effective nutritional lifestyle intervention, which consisted of nonpharmacological interventions such as weight reduction and reduced sodium intake. Approximately 70% (668/819) of patients were randomized to additional active therapy with low doses of a representative diuretic, betablocker, ACE inhibitor, or calcium – channel blockers. The nutritional- lifestyle approach was very effective and reduced blood pressure and LVM so successfully that only limited information about the effects of antihypertensive drugs on the heart could be obtained . In fact, only chlorthalidone achieved a further slight reduction in LVN (-7g compared with .placebo) and did so mainly by decreasing left ventricular volume.

The Ramipril Cardioprotective Evaluation (RACE) study group have carried out a trial designed to compare the effect on LVH of blood pressure lowering by the ACE inhibitor ramipril with that of a similar blood pressure reduction by the beta –blocker atenolol .[45] Study was multicentered with central-blind readings of the echocardiograms, in according with the Prospective Randomized Open Blinded Endpoint (PROBE) study design. Of the 193 patients enrolled in the sixteen centers, III gave echocardiograms that could be quantitatively evaluated. The study demonstrated that for the same reduction of blood pressure, LVH was significantly reduced by

ramipril only. Thus, this study aggress with the results of the meta-analysis performed by Dahlof et al and Cruickshank et al.[39, 40]

In a comparative echocardiographic study involving 151 patients , the effect of 6 months of treatment with the diuretic indapamide on regression of LVH was compared with the effect of the calcium- channel blocker nifedipine, the ACE inhibitor enalapril, the beta-blocker atenolol, and the classic diuretic hydrochlorothiazide in four parallel, double-blind studies.[37] For a similar reduction in blood pressure , the drugs, with the exception of hydrochlorothiazide, induced a similarly significant reduction in LVM. The reduction in LVM during indapamide treatment was obtained through a decrease of left ventricular wall thickness.

Gottdiener et al have recently published the results of the Veterans Affairs Cooperative Study on Single – drug. Therapy in Mild – to –Moderate Hypertension.[46] The study was designed to compare the effects on echocardiographic LVM of anti-hypertensive monotherapy with six different agents in a group of 584 males with hypertension (85% were black). After 1 year of treatment, the greatest reductions in LVM were obtained with captopril (reduction of 15g.p+0.05), and hydrochlorothiazide(reduction of 14g,p+0.08). No significant changes were observed with atenolol, diltiazem, clonidine, or prazosin. However, this study could not produce consistent results due to the high drop-out rate left less than 40 patients in each treatment arm and to the fact that no women were studied.

In conclusion, available data support the hypothesis that antihypertensive drugs that inhibit the activity of the RAS or, a lesser extent, the sympathetic nervous system reduce LVH more

consistently than drugs that stimulate these systems ACE inhibitors may have particularly beneficial effects on LVM because of their ability to inhibit or antagonize the action of growth factors. Increased production of bradykinin and, hence nitric oxide may confer further benefit to treatment by ACE inhibition. However, all or most antihypertensive drugs, if used for sufficiently long periods, may reduce LVM. Any apparent difference between the classes of antihypertensive drugs in the reversal of LVH may reflect temporal differences only. Rapid reversal of LVH, nevertheless, may be clinically important ,because reducing arterial pressure in the absence of a concomitant reduction in LVM may lead to important of coronary perfusion.[47]

Several studies have indicated that the reversal of LVH is associated with an improvement of the functional consequences of increased LVM.[13] In fact, it has been shown that reduction of LVM does not impair and may even improve systolic function as assessed by the usual echocardiographic indices of left ventricular performance. Results of studies concerning the changes of diastolic filling after reversal of LVH have been conflicting. This is probably due to the use of different methodologies by the studies. In several studies an improvement of the diastolic filling pattern has been demonstrated with the reduction of cardiac hypertrophy. A change toward normalization of autonomic nervous system activity, particularly of cardiopulomonary reflexes, and a possible reduction in arrhythmias have also been described in association with the reversal of LVH. In addition, a possible improvement of coronary flow reserve has been found to be associated with LVH regression.

To date only four studies have examined the potential clinical benefits of regression of LVH Levy et al analyzed the data from 524 participants in the Framingham Heart Study, in which the diagnosis of LVH was based on ECG criteria.[48] The report observed that the decrease of LVH toward normal, assessed by biannual serial ECG examination over a mean follow-up of 5 years, was associated with a reduction in cardiovascular risk.

Two other studies measured LVM changes detected by echocardiography. A study by Koren et al has shown that 166 hypertensive patients evaluated by echocardiography and followed up for 5.5 years; cardiovascular events occurred in 16% of patients whose LVM increased from baseline and in only 6% patients whose LVM decreased.[49]

In the second relevant study , by Yurenev et al , 304 patients with LVH or high normal LVM at baseline echographic examination were studied for 4 years and retrospectively divided into two groups according to the presence or absence of cardiovascular complications.[50] LVH regression or progression was strongly associated with the likelihood of morbid events. In fact LVH was significantly reduced only in the group without cardiovascular complications. However , in this study there was no central-blind reading of echocardiograms. Muiesan et al studied 151 patients with uncomplicated hypertension who underwent a good quality echocardiogram for left ventricular anatomy evaluation. The echocardiographic examination was repeated after a mean period of 10 years.[51] In these patients, changes in LVM were evaluated in relation to the incidence of nonfatal cardiovascular events. After

adjustment for the traditional cardiovascular risk factors, the cumulative incidence of nonfatal cardiovascular events was significantly higher in the group of patients without regression of LVH. Cox survival analysis showed the pressure of LVH at the end of follow-up to be the most important independent predictor of cardiovascular events (Relative risk+3.53,P<0.001 in patients with persistence of LVH and 1.38,p<0.1 in patients with regression of LVH).

As the follow-up in this study was relatively long, this allowed the observation that normalization of cardiac mass in patients with previous LVH was associated with a reduced risk cardiovascular events. This reduced risk became similar to that in patients without cardiac hypertrophy from baseline to end of follow-up. The results also demonstrate that either increase or lack of decrease in LVM in treated hypertensive patients, as determined by echocardiography, is associated with a worse prognosis, which becomes evident after several years.

These data strongly suggest that LVH regression carries an improved prognosis for hypertensive patients. Therefore, reversal of LVH represents a major goal for the treatment of these patients, in addition to and beyond the goal of blood pressure reduction.

Controlled studies with a strict control of treatment type changes in clinic and monitored blood pressure, and other relevant covariates, will prove the worth of LVH as a valid intermediate end point for clinical trials of hypertension.

LVH is a powerful predictor of cardiovascular morbidity and mortality, independent of blood pressure and other cardiovascular

risk factors. Available data indicate that patients who fall to achieve a reduction in LVH are more likely to suffer cardiovascular events than those in whom LVM is reduced or even normalized by antihypertensive treatment.

Further studies are needed in order to learn more about the anatomofunctional assessment of LVM and the role of LVH in the evolution of cardiovascular disease. At present, however, enough is known to consider detection, prevention, and reversal of LVH a major goal in the evaluation and treatment of hypertensive patients

AIMS

&

OBJECTIVES

AIMS & OBJECTIVES

Echocardiographic assessment of effectiveness of ACE inhibitor (Ramipril) versus beta blocker (Atenolol) in improving left ventricular function associated with essential systemic hypertension.

MATERIAL

&

METHODS

MATERIAL AND METHODS

MATERIAL :

Patients of systemic hypertension were taken from Medical OPD or cardiology/ hypertension clinic.

Patient's name, age, sex, occupational history. H/o alcohol intake, smoking, tobacco/Gutka chewing and other dietary habits H/o diabetes, obesity, myocardial infarction, weight loss hematuria, drugs history and other relevant history will be taken. Patient's family history of hypertension, CAD, diabetes mellitus, obesity etc. will also be taken.

Patient's complete examination will be done followed by routine investigations eg. blood sugar, blood urea, s. creatinine, Hb, CBC, urine routine and microscopy, x-ray chest, 12 lead ECG and lipid profile.

Only those hypertensive patients will be included in study

(1) Who are not taking any anti-hypertensive agent for

last 3 months,

2) And have no other cardiac co-morbidities,

3) and on initial echocardiography have some degree of left ventricular dysfunction in form of diastolic, systolic dysfunction or both or left ventricular hypertrophy.

These patients will be assessed in two groups after matching or known confounding factors like age, sex & socio-economic class etc.

Randomization will be done by simply using WHO series of random member.

Method

These patients will be subjected to echocardiography at two stages, first at beginning of study and second at end of 3 months of antihypertensive treatments.

The left ventricular dysfunction will be asserted in following heading –

1) LVH

2) Diastolic dysfunction

3) Systolic dysfunction

LVH : There are two methods of calculating LV mass from 2-D echocardiography.

a) Area length method

b) Truncated ellipsoid method

For both methods require short axis view of left ventricle at papillary muscle level and apical four or two chamber view at end diastole are required. Myocardial mass is equal to product of volume and specific gravity of myocardium (1.04gm/ml). Built-in software in

ultrasound unit can make both methods available so that mass is automatically calculated once all variables are fed. LV mass can also he estimated from 2-D guided, M mode measurement of LV dimension and wall thickness at papillary muscle level without measuring left ventricular major axis. Left ventricular mass is reliably obtained from left ventricular short axis dimension and simple geometric cube formula. The following equation provides an accurate determination of LV mass, according to Devereux & associated.

Left ventricular mass (gms) =

$$1.04[(LVID+PWT+IVST)^3 - LVID^3] \times 0.8 + 0.6$$

where :-

1.04 specific gravity of myocardium

0.8 – correction factor

LVID – Left ventricle internal dimension

PWT – Posterior wall thickness

IVST – Interventricular septal thickness measured at end diastole.

Diastolic dysfunction

Based on Doppler velocity pattern, diastolic dysfunction is divided into three categories-

a) Relaxation abnormalities

b) Restrictive physiology

c) Pseudonormalization

a) Relaxation abnormalities: Abnormal myocardial relaxation is characterized by a constellation of following abnormalities-

1) Prolonged IVRT (Isovolumic relaxation time) >110msec.

2) Low E velocity (early filling velocity) and high A velocity (A velocity = late filling velocity).

3) Revised E/A ratio (<1.0)

4) Prolonged decelleration time (DT) >240msec.

b) Restrictive physiology : Is characterized by following diastolic parameters :

i)   Shortened IVRT (<60msec)

ii)   High E velocity and low A velocity

iii)   Increased E/A ratio >2.

iv)   Shortened deceleration time (<150msec).

Systolic dysfunction

To evaluate systolic function two parameters are used :

1)   Fractional shortening or ejection fraction.

2)   Cardiac output

1)   Fractional shortening is a percentage change in left ventricle cavity dimension with systolic contraction and can be calculated from the following equation.

Fractional shortening = (LVED-LVES)/LVED×100%

Where LVES - LV end systolic dimension

LVED – LV end diastolic dimension

ection fraction : Represents stroke volume as a percent

f end diastolic left ventricular volume-

= (EDV-ESV)/E ×100%

ere   EDV- End diastolic volume of LV

ESV- End diastolic volume of LV

uinoners and co-authors proposed a simplified method for

ination of ejection fraction by measuring left ventricle

sion.

IF = (%OD^2) +[(1-%OD^2)(%DL)

Whereas - %OD^2 = [(LVED- LVES) /LVED] ×100%

OBSERVATIONS

OBSERVATIONS

We included a total of 52 patients of essential hypertension fulfilling the following criteria as

1. Who are not taking any antihypertensive agents for minimum of last 3 months.

2. Have no other cardiac co-morbidities.

3. And have on initial echocardiography some degree of left ventricular dysfunction, in form of diastolic, systolic dysfunction or both or left ventricular hypertrophy. All patients were followed up for 6 months and echocardiography was performed at initiation of therapy and at end of 6 months. Patients were followed up at regular intervals of 1 month. During follow up, a total of 10 patients were lost.

Demographic Characteristics :

Age of study population was in range of 32 – 76 years with mean age of 54.5 years. Maximum numbers of patients were in the age group of 50 – 55 years. Among 42 patients 35 were males, constituting the 83.33% of study population and 7 were females constituting the 16.7% of study population. Male to female ratio as a whole in the study was 5:1.

Age wise distribution of Patients:

Age range (in Years)	Male No. (%) male population	Female No. (%) Female population	Total No. (%) of study
30 – 34	1 (03%)	0 (0%)	1 (2%)
35 – 39	2 (05%)	1 (14%)	3 (7%)
40 – 44	4 (11%)	0 (0%)	4 (9%)
45 – 49	6 (17%)	0 (0%)	6 (14%)
50 – 54	7 (20%)	3 (42%)	10 (24%)
55 – 59	5 (14%)	2 (29%)	7 (17%)
60 – 64	5 (14%)	1 (14%)	6 (14%)
65 – 69	2 (05%)	0 (0%)	2 (5%)
70 – 74	2 (05%)	0 (0%)	2 (5%)
75 - 80	1 (03%)	0 (0%)	1 (2%)

The patients were randomized in two groups, Group 'A' and group 'B'. Patients of group A received tablets Ramipril 2.5 – 20 mg / day (average 6.75 mg / day) and group B patients received tablets tenolol 25 – 100 mg / day (mean 62.5 mg%) to keep their blood pressure $\leq$ 140 mm Hg systolic and $\leq$ 90 mm Hg diastolic.

Comparative study

1.Demographic characteristics: In group A there were total 22 patients out of which 19 (86%) were males and 3 (14%) were females, with maximum number of patients in age range 50 – 59 years. The mean age of group A patients is 54 years ± 10 years.

Age wise distribution of Patients in Both Groups :

Age range (in Years)	Group A			Group B		
	Male	Female	Total	Male	Female	Total
30 – 39	2	-	2	1	1	2
40 – 49	5	-	5	4	-	4
50 – 59	6	3	9	3	2	5
60 – 69	4	-	4	5	1	6
70 – 79	2	-	2	3	-	3
Total	19	3	22	16	4	20

In group B there were total 20 patients, out of which 16 (80%) were males and 4 (20%) were females. Majority of patients (80 patients) belong to age group of 60 – 69 years with a mean age of 56.5 years ± 9.6 years.

2.Pretreatment blood pressures : In group A total 23 patients had stage I hypertension (According to JNC VII classification)

Blood pressure stage wise distribution in both groups.

Blood pressure study (mm Hg)		Group A	Group B
Stage I	Systolic (140 – 159) Diastolic (90 – 99)	5 (23%)	7 (35%)
Stage II	Systolic (≥160) Diastolic (≥ 100)	17 (77%)	13 (65%)
Total		22	20

Age wise Distribution of Male & Female in Group A

Numbers vs Age Range bar chart (Male, Female)

Age wise Distribution of Male & Female in Group B

Numbers vs Age Range bar chart (Male, Female)
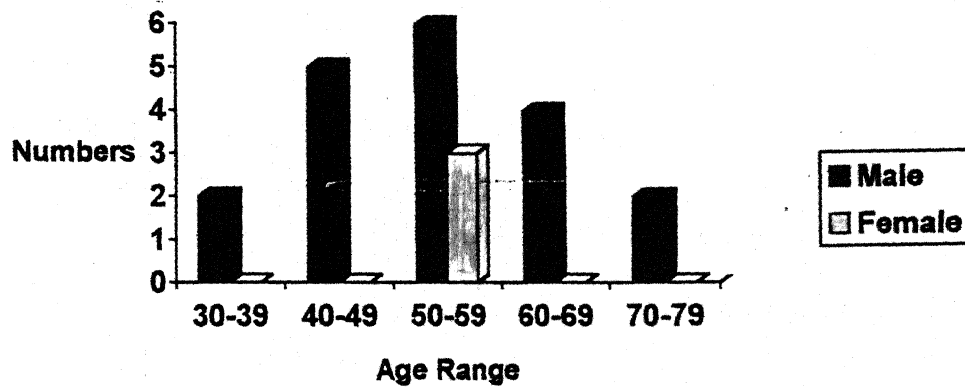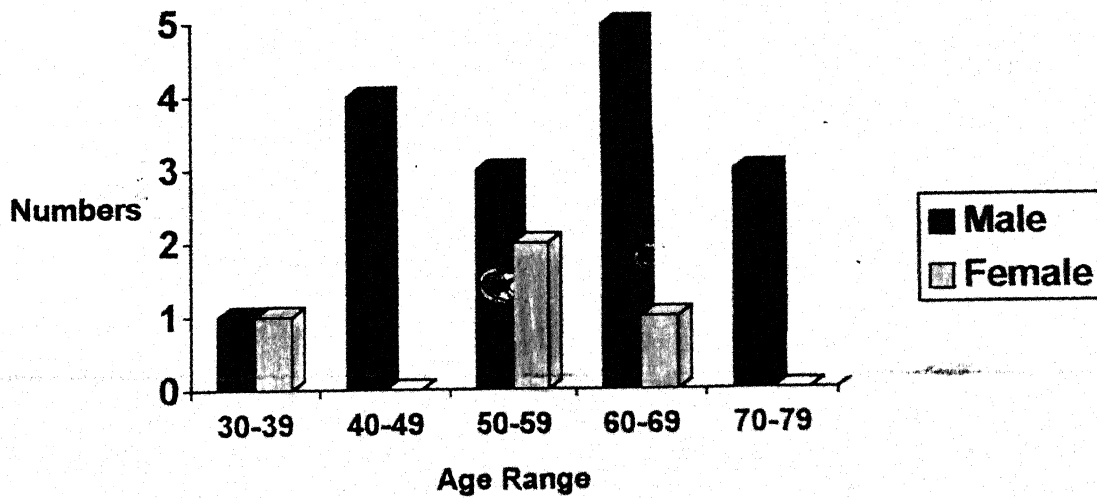
(When discrepancies existed between diastolic and systolic staging, higher stage was taken) and 73% patients had stage II hypertension. In group B, a total 35% patients had stage I hypertension and 65% had stage II hypertension.

3.Blood pressure distribution in both groups

Systolic BP(mm Hg)	Group A	Group B	Diastolic BP(mm Hg)	Group A	Group B
150-159	8	8	80-84	0	0
160-169	4	5	85-89	0	0
170-179	3	6	90-94	4	8
180-189	5	1	95-99	9	6
190-199	1	0	100-104	7	6
200-209	1	0	105-109	2	0
Total	22	20		22	20

The mean systolic BP in group A was 170 mm Hg ± 12.9 and 36% patients had their systolic blood pressure in range 150 – 159 mm Hg. The mean diastolic pressure in group A was 98.5 mm Hg ± 4.4 and 40% patients had their diastolic BP in range 95 – 99 mm Hg.

The mean systolic BP in group B was 164.5 mm Hg ± 9.7 with 40% patients had their systolic BP in range 150 – 159 mm Hg. The mean diastolic BP was 96.5 mm Hg ± 3.8 for group B patients and 40% patients had their systolic pressure in range of 90 – 94 mm Hg.

Blood Pressure stage wise Distribution in both groups(According to JNC VII)

Numbers

Legend:
- ■ Stage 1
- □ Stage 2
- ■ Total

Groups: Group A, Group B

Systolic Blood Pressure stage wise Distribution in both groups

Numbers

mm Hg: 150-159, 160-169, 170-179, 180-189, 190-199, 200-209

Legend:
- ■ Group
- □ Group
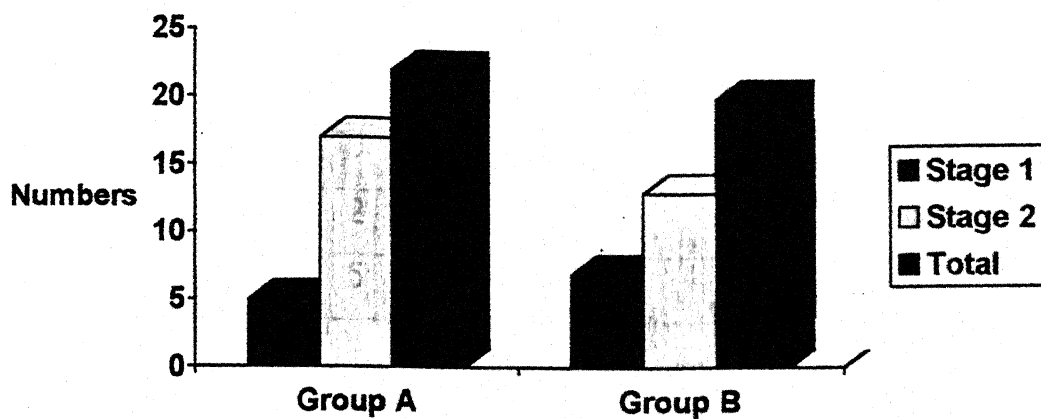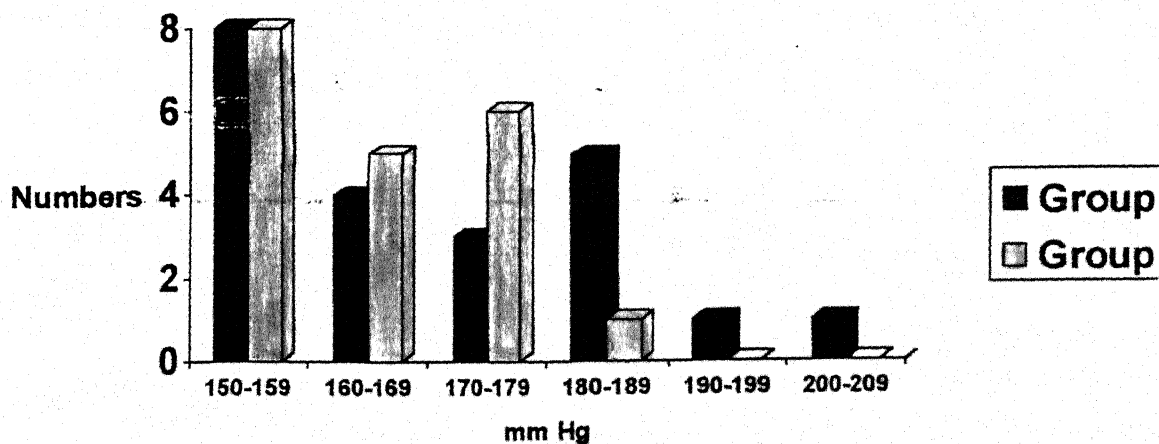
4.Blood pressure fall in both groups after treatment

Systolic BP fall (mm Hg)	Group A	Group B	Diastolic BP fall (mm Hg)	Group A	Group B
<10	0	0	<5	1	1
11-19	1	2	6-10	3	4
20-29	3	5	11-15	8	9
30-39	10	8	16-20	5	5
>40	8	4	>20	4	1
Total	22	20		22	20

The mean systolic BP fall in group A was 35.7 mm Hg ± 8.3 and mean diastolic BP fall in group A was 13.7 mm Hg ± 5.5. In group B the mean systolic BP fall was 30.5 mm Hg ± 9.1 and mean diastolic BP fall was 12.7 mm Hg ± 4.6.

5.Diastolic function

Pre treatment distribution of E/ A ratio in both groups

E/A Ratio	Group A	Group B
0.7-0.74	6	4
0.75-0.79	2	5
0.80-0.84	7	4
0.85-0.89	3	1
0.90-0.94	2	4
0.95-0.99	2	2
Total	22	20

Diastolic Blood Pressure wise distribution in both groups

Numbers

Group A
Group B

80-84   85-89   90-94   95-99   100-104   105-109

mm Hg

Systolic Blood Pressure fall in both groups after treatment

Numbers

Group A
Group B

0-10   11-19   20-29   30-39   40-49   105-109

mm Hg
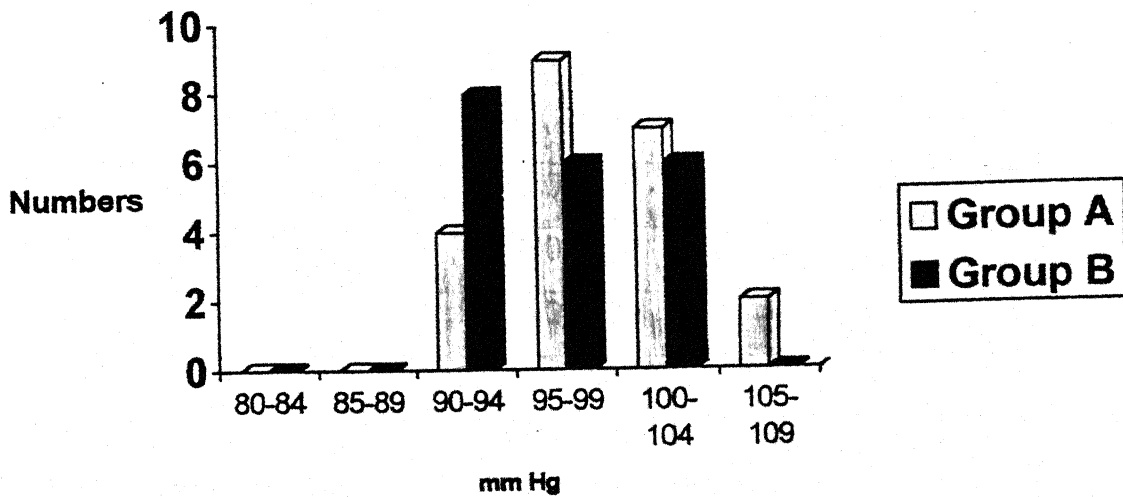
The pretreatment mean E/ A ratio for group A was 0.81 and group B was 0.82

Post treatment E/ A ratio

E/A ratio	Group A	E/A Ratio	Group B
0.90-0.94	2	1.10-1.19	4
0.95-0.99	6	1.20-1.29	6
1.00-1.04	6	1.30-1.39	4
1.05-1.09	5	1.40-1.49	2
1.10-1.14	2	1.50-1.59	3
1.15 -1.19	1	1.60-1.69	1
Total	22		20

The post-treatment mean E/A ratio in group A was 1.02 and mean E/A ratio in group B was 1.30.

6.Systolic function

Ejection Fraction: The mean EF for group A was 56.4% and for group B was 62.4% and after treatment it was 56.15% for group A and 56.4% for group B.

Diastolic Blood Pressure fall in both groups after treatment

Numbers vs mm Hg (0-5, 6-10, 11-15, 16-20, 20-24) for Group A and Group B
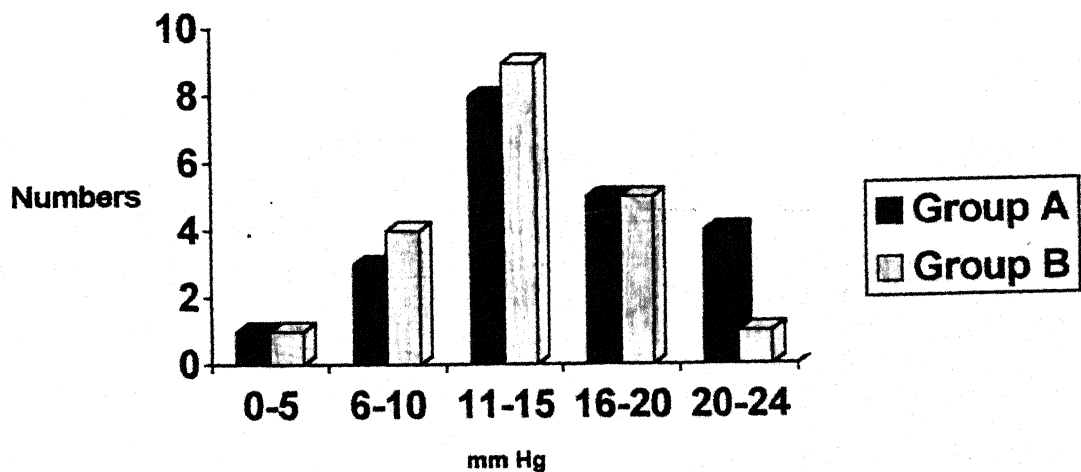
Pretreatment E/A Ratio in Both Groups

Numbers vs E/A Ratio (0.7-0.74, 0.75-0.79, 0.80-0.84, 0.85-0.89, 0.90-0.94, 0.95-1) for Group A and Group B

Post treatment E/A Ratio in Group A

Legend:
- 0.90-0.94
- 0.95-0.99
- 1.00-1.04
- 1.05-1.09
- 1.10-1.14
- 1.15-1.19

Values: 9%, 5%, 9%, 27%, 27%, 23%

Post treatment E/A Ratio in Group B

Legend:
- 1.10-1.19
- 1.20-1.29
- 1.30-1.39
- 1.40-1.49
- 1.50-1.59
- 1.60-1.69

Values: 15%, 5%, 20%, 30%, 20%, 10%
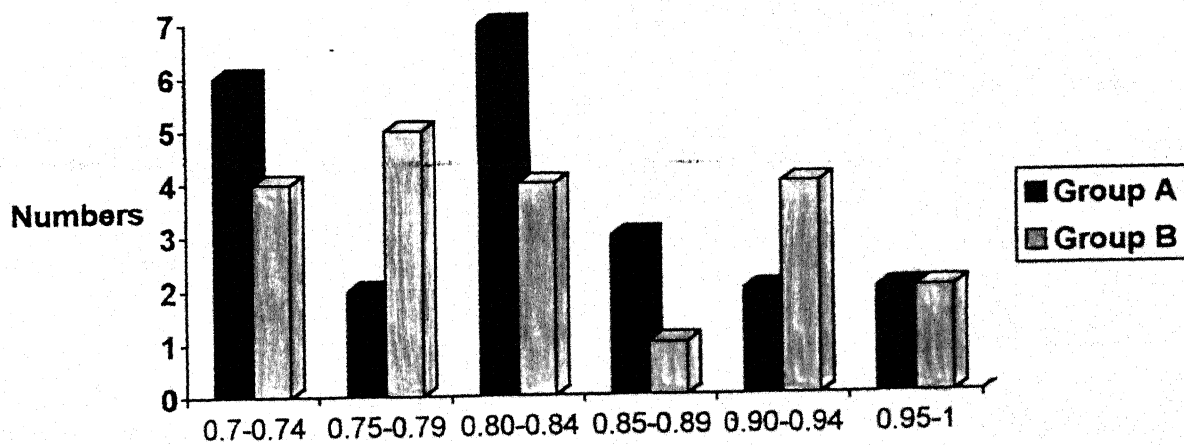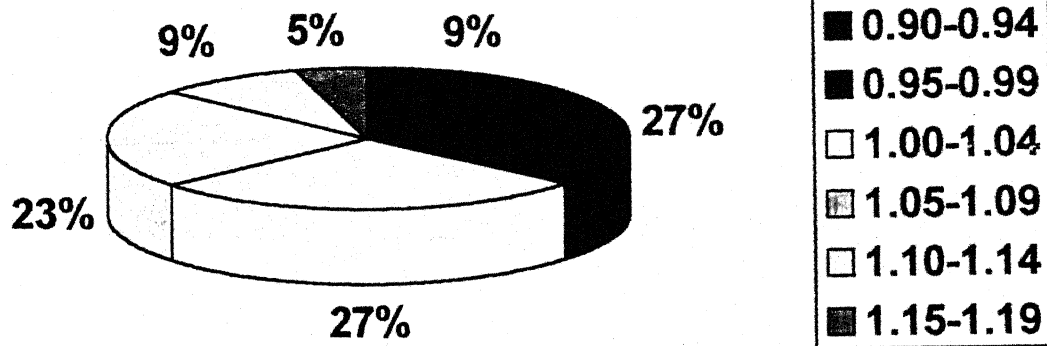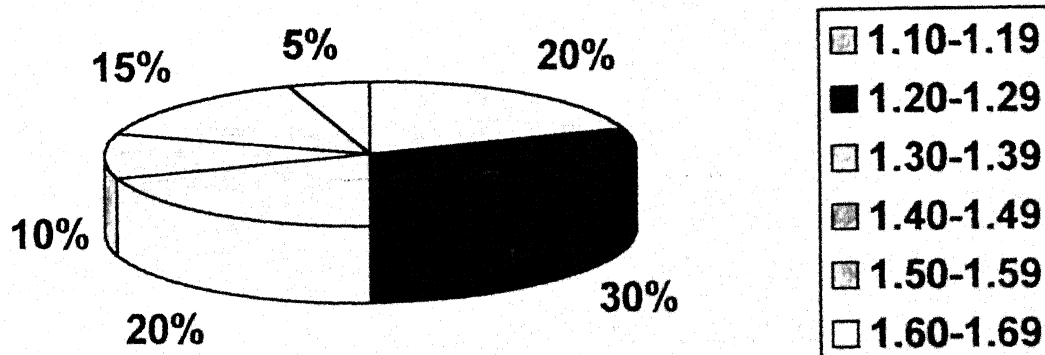
Pre and Post treatment Ejection Fraction in both groups

Ejection Fraction(%)	Group A	Group B
Pretreatment	54.4 %	62.4%
Post treatment	56.15%	56.41%

7.Left Ventricular Mass Index (LVMI)

Prior to treatment the mean LVMI for group A was 120 gm / m^2 ± 18.8 and for group B was 122.5 gm / m^2 ± 13.6..

Prior to treatment Left Ventricular Mass Index (LVMI)

LVMI (gm/m^2)	Group A	Group B
90-99 gm/m^2	6	0
100-109 gm/m^2	7	4
110-119 gm/m^2	1	5
120-129 gm/m^2	3	5
130-139 gm/m^2	1	3
140-149 gm/m^2	4	3
Total	22	20

Post treatment LVMI : The mean LVMI for group A was 105 gm / m^2 ± 15.5 and for group B was 117.5 gm / m^2 ± 11.8.

Pre & Post Treatment Ejection Fraction in Both Groups

Percentage (y-axis: 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76)

Legend: Group A, Group B

X-axis: Pretreatment, Posttreatment

Number

Pre treatment left Ventricular Mass Index (LVMI) in both groups

Total Number (y-axis: 1, 4, 7, 10)

Legend: Group A, Group B

X-axis: 90-99, 100-109, 110-119, 120-129, 130-139, 140-149
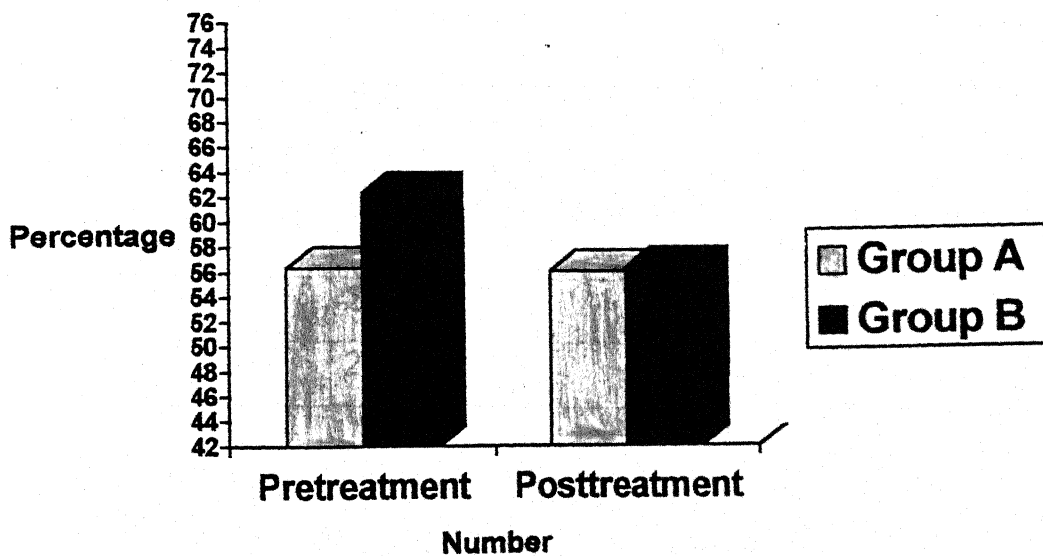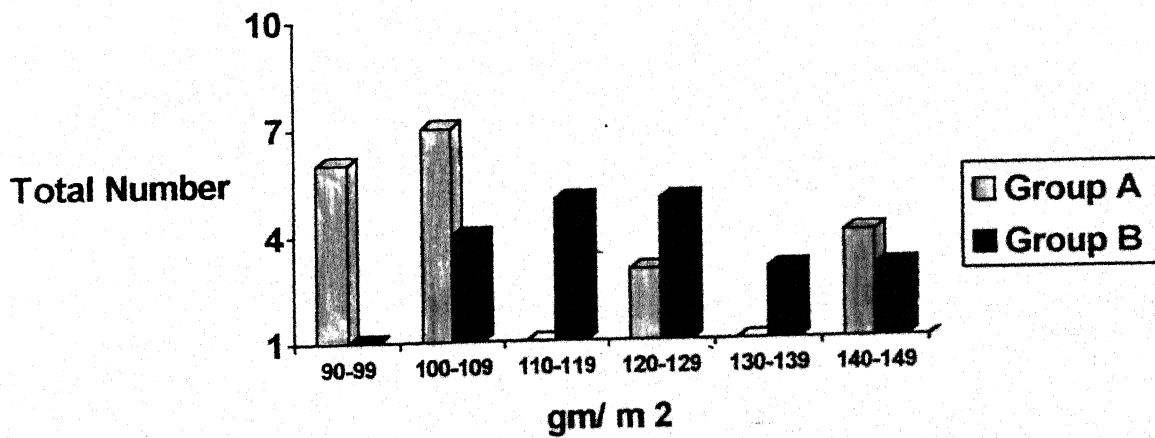
gm/ m 2

Post treatment LVMI in both groups

LVMI (gm/m^2)	Group A	Group B
70-79	2	0
80-89	2	1
90-99	3	4
100-109	4	4
110-119	5	6
120-129	4	2
130-139	2	4
Total	22	20

Post treatment left Ventricular Mass Index (LVMI) in both groups
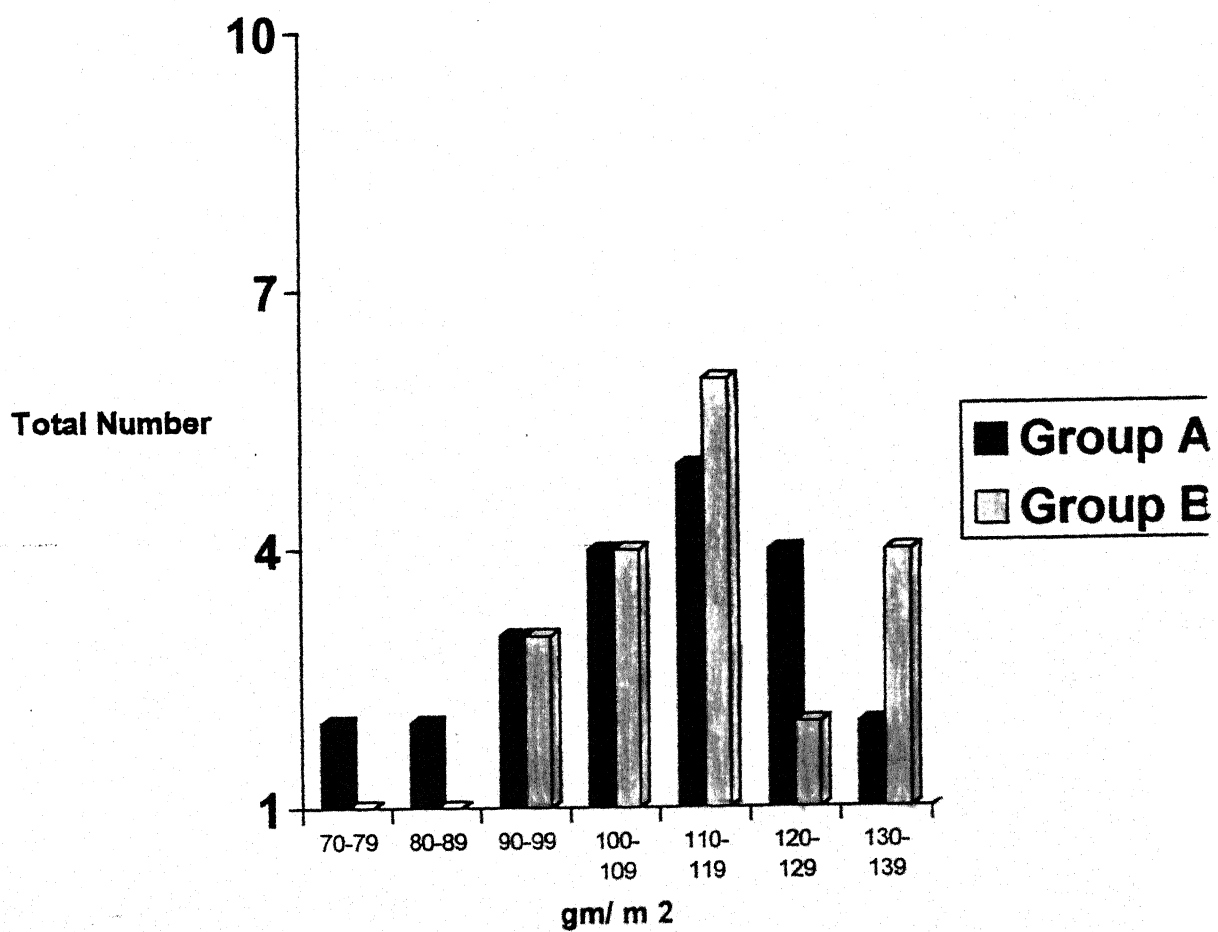
DISCUSSION

DISCUSSION

Hypertension is an important public health problem. Although easily detectable, asymptomatic and usually easily treatable, yet, it leads to lethal complication as in majority it is either untreated or is inadequately treated.

Diastolic and systolic dysfunctions have been observed early in the course hypertension and either or both may lead to heart failure. Left ventricular hypertrophy (LVH) is also common cardiac abnormality in hypertension and is found in about 30% of untreated hypertensive patients on echocardiography. The presence of LVH is consistently and strongly related to subsequent cardiovascular morbidity and mortality and its reversal leads to improved survival.

Richard B Deveruex proposed that different anti hypertensives despite reduction in BP of similar degree differ in their ability to regress the left ventricular hypertrophy. As the Angiotensin II and NE play an important role in the pathophysiology of left ventricular hypertrophy. ACE Inhibitor and Beta blockers have a define role in the regression of left ventricular hypertrophy.

Present study was conducted in Department of Cardiology, M.L.B. Medical College, Jhansi. A total of 52 patients were included in the study who had hypertension, and on echocardiography there is either, systolic, diastolic dysfunction or LVH and not taking any antihypertensive medication for last 3 months. They were randomly assorted into 2 groups. Group A consist of 22 people with age of 54.5

years and out of which 86% were male. Out of this group 23% had stage I hypertension and 77% had stage II hypertension according to JNC VII classification. This group received ACE inhibitor Rampril to achieve the target blood pressure $\leq$ 140/90mm after initial echocardiography study.

Group B consist of 20 persons with a mean age of 56.4 years and out of which 80% were male.

In group B, 35% patients had stage I hypertension and 65% had stage II hypertension according to JNC VII classification this group received Atenolol as selective B blocker to achieve the target blood pressure $\leq$ 140/90mm,these patients were followed up at regular interval of 3 weeks to ensure the optimal blood pressure control. During follow up period a total 10 patients lost.

After 6 months of treatment repeat echocardiography was performed and the finding was analysed in context to initial echocardiography at beginning of therapy.

In both group there is improvement in the ventricular relaxation pattern (measured from of E/A ratio) in group A (receiving ACE inhibitor) the mean E/A ratio was improved from 0.8% to 1.02. In group B receiving the B blockers the E/A ratio improve from 0.82 to 1.22 and this finding is statistically significant(p value <0.032). This finding is in agreement with previous finding of Gosse P. et al, Hevi Y et al , Salcedo A et al .

Ventricular relaxation is energy dependent is active process and involves the activation of SERCA-2 (Sarco endo plasmic reticulum Ca^{2+} ATP are) through phosphorylation of phospholamban . Increased ventricular mass increase the oxygen demand and

ischemia at cellular level   result in poor relaxation pattern.A reduction in ventricular mass improves the energy management in myocardium and improve the ventricular relaxation pattern.

Giovdano F.S. et al, and Brounwald E opined that mechanical strain and several agonists such as NE down regulate the expression of SERCA-2 particularly in hypertrophied myocardium. This explains the improvement .in ventricular relaxation pattern with use of anti hypertensive drugs particularly B blockers   which enhance the re expression of SERCA-2 and thus reuptake of free Ca ^{21} in endoplasmic reticulum.

Pretreatment the ejection fraction in group A (treated with ACE) was 54.4% and post treatment it was 54.15, there was decline of 0.46% . Though in other studies there was an improvement of ejection fraction particularly if there was suppression of ejection fraction at beginning of therapy like CONCENSUS and SOLVD M Eng J Med (1992).

As ventricular hypertrophy is a compensatory response to increase after load imposed by hypertension and a decrease in LVH lead to poor contraction in initial phase, though in long term there is improvement in EF. As this study was under taken for 6 month period and mean EF was calculated from both, patient with heart failure and those with normal EF .It imprudent to derive any conclusion.

In group B the pretreatment EF was 62% and post treatment it was 56.4% a negative change of 6.4%. This finding is consistent with normal physiological response to B blockers as sympathomimetic effect leads to positive ionotropic action and B blockers prevent this

action. But various studies using B blocker in heart failure whether associated with LVH or not shown an improvement in mortality despite an early reduction of EF (MCD).

In Group A pretreatment mean left ventricular mass index was 120gm/m2 and after 6 month of treatment the mean LVMI was 105.6 gm/m2. There was 12% decrease is the LVMI. Angiotensin II plays an important role in the development of LVH. Eichhoron EJ, et al and Pfeffers in his elegant study proved that prevention of angotensin generation has in important role in the management of LVH and HF(Pfeffers MA et al). Opie L.H. et al also proposed that angiotensin II also promotes the proto oncogenes thus ventricular hypertrophy through protein Kinase C.

In group B pretreatment LVMI was 122.5gm/m and after treatment with Atenolol it was 117.5gm/m,showing a decrease of 4% in LVMI. This finding is significant (p < o.043). these finding are in agreement with the studies of other authors like Agabiti Rosei E,et al and Salcedo A et al and R. B. Devereux et al. The probable cause for LVMI reduction with ß blockers is blockade of neurohormonal changes responsible for myocardial hypertrophy and fibrosis

CONCLUSION

CONCLUSION

The main facts drawn from this study are

1)- The different antihypertensive agents despite lowering the blood pressure to target level differ in their ability to regress the LVH and other parameters (pathological changes) related to Hypertensive Heart Disease. Probable cause for this difference is not their different ability to reduce the after load but their different impact on neurohormonal process responsible for LVH. This conclusion has important long-term consequences as regression of LVH in these patients leads to improved survival. In my study ACE Inhibitor-Ramipril was associated with more regression of LVMI than ß blocker Atenolol and this finding is statistically significant.

2)- The parameter for evaluation of diastolic dysfunction (E/A ratio) was appreciably improved by ß blocker than ACE Inhibitor Ramipril.

Thus ß blockers may prove more beneficial in isolated diastolic heart failure in elderly.

3)- The ejection fraction, a measurement of systolic function is depressed with use of ß blockers in comparison to ACE Inhibitor Ramipril, though this finding was statistically not significant ($p > 0.89$).

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WORKING PROFORMA

Name   :

Age/ Sex   :

Address   :

Pretreatment BP   :

 ECG   :

X-Ray Chest P/A View   :

Date	BP	Treatment Given

Maharani Laxmi Bai Medical College, Jhansi

Cardiology Division

Echocardiography Report

Name... Age........................Sex...................Date......................

Echo No... VCR Tape No..

Height....................cms Weight............................kg BSA.............m²...................... Ref. By........................

Clinical Diagnosis

Quality of Imaging Poor/Adequate/Good Done By Dr................. Checked By Dr..............

MITRAL VALVE

Morphology : AML-Normal / Thickening / Calcification / Flutter / Vegetations / Prolapse / SAM/Doming

PML- Normal/Thickening/Calcification/Prolapse/Paradoxical Motion/Fixed

Subvalvular deformity - Present / Absent Score.............................

MV Area........................

Doppler : Normal / Abnormal

Mitral stenosis - present / Absent

EDG..............mmHG - MDG................mmHg MVA............cm²

Mitral regurgitation - Absent / Trivial / Mild / Moderate / Severe

TRICUSPID VALVE

Morphology : Normal/Atresia/Thickening/Calicification/Prolapse/Vegetations/Doming

Doppler : Normal/Abnormal

Tricuspid Stenosis - Present/Absent

EDG...........mmHg - MDG..........mmHg

Tricuspid regurgitation - Absent/Trivial/Mild/Moderate/Severe

Velocity ....cm/sec. Pred RVS = PAP + RAP......................mmHg

PULMONARY VALVE

Morphology : Normal/Atresia/Thickening/Doming/Vegetations

Doppler : Normal/Abnormal

Pulmonary stenosis - Present/Absent Level

PSG...........mmHg Pulmonary annulus............mm

Pulmonary regurgitation - Present/Absent

Early diastolic gradient.........mmHg End diastolic gradient...................mmHg

AORTIC VALVE

Morphology : Normal/Atresia/Thickening/Doming/Vegetations No. of Cusps 1/2/3/4

Doppler : Normal/Abnormal

Aortic Stenosis - Present/Absent Level

PSG........mmHg Aortic Annulus..............mm

Aortic regurgitation - Absent/Trivial/Mild/Moderate/Severe

ASUREMENTS

	Normal Values		Normal Values
Aorta.....................(21-22 mm/m²)		LAed.........................(21-22 mm/m²)	
LVes.....................(21-40 mm)		LV ed.......................(35-60 mm)	
RVes.....................(6-10 mm)		PW (LV)ed.................(7-11 mm)	
RVed.....................(20-38 mm)		RV Anterior WAll.............(upto 5 mm)	
EF.........................(62-80%)			

S Motion   Normal/Flat/Paradoxical

S

HAMBERS

LV   Normal/Enlarged/Clear/Thrombus/Hypertrophy
      Contraction - Normal/Reduced

LA   Normal/Enlarged/Clear/Thrombus

RA   Normal/Enlarged/clear/Thrombus

RV   Normal/Enlarged/Clear/Thrombus

PERICARDIUM   Normal/Thickening/Calcification/Effusion

Wall Motion Analysis

Segemental Level	AS	ANT	ANT-LAT	POST-LAT	INF	IS
BASAL						
MID						
APICAL						

REMARKS

DIAGNOSIS

FINAL IMPRESSION

Consultant

Pre and post treatment profiles of patients in group A

S. No	Age Yrs	Sex	BP(mmHg)	E/A ratio	EF (%)	LVMI gm/m2	BP mmHg	Fall in BP mmHg Systolic	Fall in BP mmHg Diastolic	Diastolic F E/A ratio	Systolic F EF (%)	LVMI gm/m2	Reduction In LVMI gm/m2
1	53	M	156/100	0.95	54	126	140/86	16	14	1.05	58	127	5
2	64	M	170/96	0.89	58	128	136/90	34	6	1.12	60	116	12
3	48	M	154/94	0.84	62	106	130/82	24	12	0.96	60	92	14
4	52	M	164/96	0.72	60	104	130/80	34	16	1.04	62	96	8
5	56	F	158/98	0.82	56	96	126/76	32	22	0.96	57	88	8
6	52	M	150/100	0.815	59	126	122/78	28	22	1.14	16	118	8
7	72	M	180/90	0.7	60	104	146/90	36	0	1.26	59	92	12
8	52	F	210/108	0.716	54	96	140/92	60	16	0.96	58	88	8
9	64	M	180/102	0.73	56	140	136/88	44	14	1.06	60	130	10
10	48	M	164/98	0.85	46	106	126/88	38	18	1.14	52	100	6
11	76	M	180/90	1.29	59	110	136/76	44	14	1.12	64	92	18
12	64	M	156/96	0.87	61	106	110/70	46	26	1.08	62	98	8
13	42	M	162/98	0.82	53	96	116/72	46	26	1.26	59	82	14
14	53	M	156/104	0.715	52	140	136/90	20	14	1.1	60	132	8
15	36	M	190/108	0.72	46	104	146/94	44	10	0.96	56	92	12
16	52	M	166/94	0.84	62	90	126/84	30	10	1.12	61	79	11
17	50	F	170/100	0.76	58	68	140/80	30	20	1.02	62	76	2
18	56	M	180/96	0.91	64	102	136/82	44	14	1.12	64	90	12
19	36	M	156/98	0.82	54	96	120/80	36	18	1.06	59	89	7
20	46	M	150/100	0.92	55	142	116/88	34	12	0.96	60	130	12
21	66	M	170/98	0.79	60	133	132/84	38	14	0.94	64	119	14
22	44	M	180/104	0.81	52	126	130/70	50	24	1.02	62	113	13

Pre and post treatment profiles of patients in group B

S. No	Age Yrs	Sex	BP (mmHg)	E/A ratio	EF (%)	LVMI gm/m2	BP mmHg	Fall in BP mmHg Systolic	Diastolic	Diastolic F	Systolic F	LVMI gm/m2	Reduction In LVMI gm/m2
1	64	M	170/96	0.91	64	110	146/86	24	10	1.26	60	108	2
2	52	M	160/98	0.72	61	126	130/84	30	14	1.36	60	113	13
3	45	M	146/94	0.96	62	136	110/82	36	12	1.36	62	135	11
4	74	M	180/104	0.72	54	118	140/90	40	14	1.16	54	112	6
5	60	M	164/100	0.81	56	146	136/86	18	14	1.26	58	137	9
6	40	M	160/96	0.76	60	126	132/88	28	8	1.22	60	119	7
7	50	M	146/94	0.9	52	116	126/78	20	16	1.32	54	102	14
8	56	F	170/100	0.79	44	136	126/90	44	10	1.28	50	123	13
9	36	F	166/96	0.83	53	104	136/84	30	12	1.16	54	96	8
10	75	M	170/90	0.91	58	122	132/90	38	0	1.24	58	114	8
11	32	M	148/100	0.76	62	127	130/80	18	20	1.32	60	115	12
12	48	M	156/92	0.77	36	116	116/80	40	12	1.42	42	106	10
13	70	M	170/94	0.86	54	132	136/82	34	12	1.12	56	126	6
14	58	F	156/94	0.84	60	122	116/76	40	18	1.56	58	115	7
15	62	M	150/98	0.786	61	146	122/74	28	24	1.48	60	137	9
16	56	M	170/100	0.68	52	138	140/86	30	14	1.52	54	120	15
17	60	F	148/92	0.91	54	116	110/72	38	20	1.56	56	102	14
18	60	M	170/104	0.82	58	108	134/86	36	18	1.6	56	96	12
19	62	M	160/94	0.96	60	116	126/80	34	14	1.12	58	108	8
20	41	M	156/96	0.73	62	104	132/86	24	10	1.56	60	92	12